Innovative 2D/3D Biotextiles for Potential Bone Tissue Engineering Applications

L.R. Almeida[1,2], A.L. Oliveira[1,2,3], R.A. Sousa[1,2], V.M. Correlo[1,2], P. Lisboa[1,2], A.P. Marques[1,2], A.S. Ribeiro[4], C. Silva[4], J. Morgado[5], R. L. Reis[1,2]

[1]3B's Research Group–Biomaterials, Biodegradables and Biomimetics, Univ. of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, AvePark, Guimarães, Portugal; [2]IBB–Institute for Biotechnology and Bioengineering, PT Associated Laboratory, Guimarães, Portugal; [3]Department of Health Sciences, Portuguese Catholic University, Viseu, Portugal. [4]CeNTI, Centre for Nanotechnology and Smart Materials, V. N. Famalicão, Portugal.[5]CITEVE, Technological Center for Textile and Clothing Industry.

Objectives: Bone tissue engineering represents a specialised niche within the biomedical field to which textile technologies can markedly contribute. Textile-based technologies are considered as potential routes for the production of scaffolds for TE applications, as they present superior control over design and reproducibility. This work aims at developing novel 2D/3D textile structures based on different polymeric materials and to engineer their surfaces in order to promote and control cell adhesion and proliferation.

Methods: Natural and synthetic polymers such as silk, polybutylene succinate (PBS) and poly(ethylene therephtalate) (PET) were selected to be extruded into multifilament yarns and processed into different structures such as Jersey, Rib and Piqué and 3D spacer. Furthermore, different surface modifications were performed (acid/alkaline treatment, UV radiation and plasma) for increasing cell adhesion and proliferation. The immobilization of different proteins on the surface of modified materials was also performed. All textile constructs were characterized in terms of porosity, morphology and mechanical properties by μ-CT, SEM and DMA analysis. The effectiveness of the surface modifications was assessed by FTIR, XPS and contact angle measurements.

Results and Discussion: The obtained constructs present very reproducible intra-architectural scaffold geometry with high surface area and exhibiting a wide range of porosities. By the above mentioned techniques it was possible to validate the effectiveness of the proposed treatments in modifying the surface of the materials. In addition, BSA was successfully immobilized on the obtained surfaces. Cell adhesion and proliferation studies are presently ongoing to validate the developed constructs for the proposed application.

Conclusions: By the proposed textile methodologies it was possible to develop a diversity of constructs with a wide range of porosities and surface area. The effective modification and immobilization of biomolecules on the surface of the biotextiles are important outcomes that are expected to have a positive impact in their biological performance.